



# WRS Future Convenience Store Challenge Preliminary Competition 2018

## “Toilet Cleaning” Task

### Rulebook

2018/02/02

## Revision History

February 2, 2018

- A subject about an energy saving was added.

January 15, 2018

- First Draft

## 0. Definitions of Terminology

Term	Definition
Mobile Robot	A robot that can move autonomously.
Infrastructure (Robot)	Unique infrastructure that can be installed inside convenience stores to assist in tasks of the robot. This equipment includes markings, IC tags, sensors, actuators and auxiliary tools that add equipment to products. Infrastructure made up of sensors and actuators can also be seen as stationary robots.
Manipulator	Robot arms, hands and other equipment that execute operations which can be equipped or installed on a mobile robot or as part of the infrastructure.
Product	Products found at a convenience store.
Customer	Person who visit the store to purchase products.
Container	Container used to hold and transport multiple products. A container may also be called a carton.
Product Display Area	Section of the convenience store with display cases or book shelves installed.
Cashier Area	Section of the convenience store with the cashier counter installed.
Restroom Area	Section of the convenience store with the toilet installed (Abbreviation: Restroom).
Aisle Area	Section of the convenience store for customers and mobile robots to come and go (Abbreviation: Aisle).
Backyard Area	Area of the convenience store customers are not permitted (Abbreviation: Backyard).
Home	Standby station of the mobile robot. The standby station is located in a designated place inside the backyard area.
Display Case A	Case for displaying products. There are no products placed in this display initially.
Display Case B	Case for collecting disposal items. Multiple products are mixed in this case initially.

## 1. Overview

This challenge aims to develop technology to automate restroom cleaning, which is one daily task of employees at a convenience store. Participants in this competitive task shall develop a robot that autonomously moves and performs cleaning operations as well as infrastructure (robot) to perform cleaning operations that can be installed inside of the restroom area. In this competitive challenge, participants will use the robots and infrastructure they develop to compete in the proficiency of operations via the systems developed to perform cleaning demonstrations of the toilet and floor in a simulated restroom space.

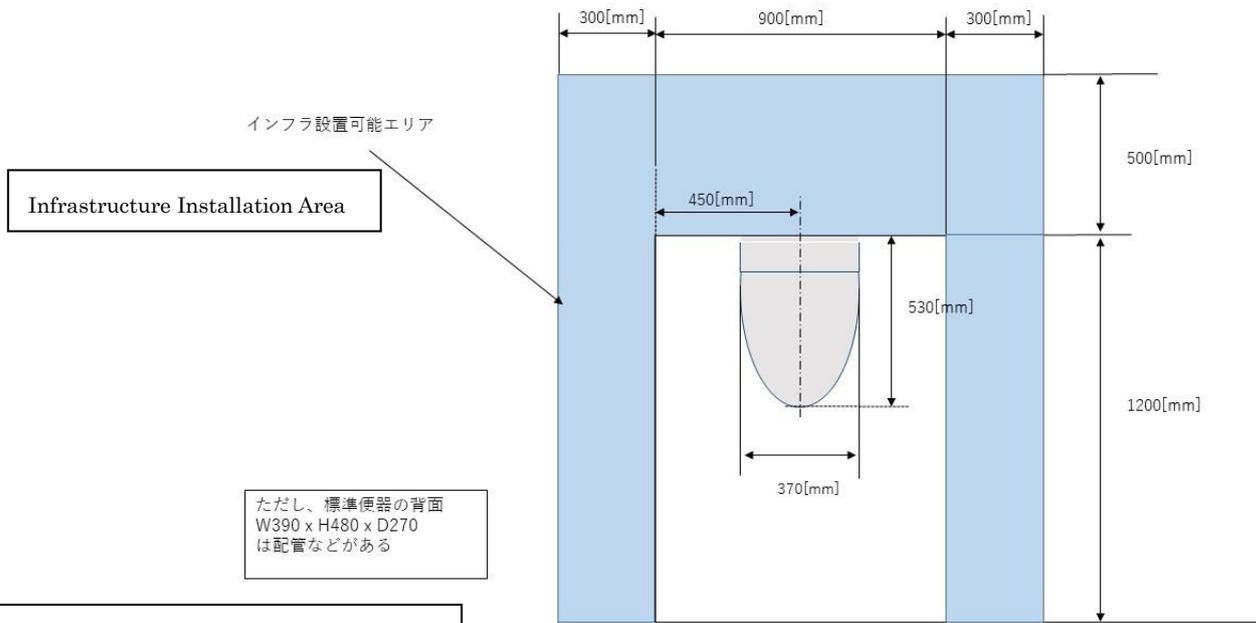
The restroom area is made up of a toilet, floor and an area to install infrastructure in the layout shown in Figure 1.

The demonstration will consist of the following two types of tasks:

- Cleaning simulated urine on the toilet (rim {top of toilet bowl} and toilet seat {when up}) and floor around the toilet. The inside of the toilet bowl is outside the scope of this task.
- Cleaning garbage scattered on the floor (roll and scraps of toilet paper).

Furthermore, a comprehensive explanation about the cleaning will be described later.

In addition, the proposed system must contribute to energy saving in general or to the clerks' work reduction that leads to energy saving at the convenience store businesses.



However, the backside of the standard toilet bowl (W390 x H480 x D270) has piping and other fixtures.

Figure 1: Layout of Restroom Area

## 2. Flow of the Competitive Task

The time limit for this competitive task will be 20 minutes. The competitive task will proceed in the following order:

- (1) Renovation time
- (2) Setting time
- (3) Cleaning demonstration

The total amount of time for (1) to (3) is 20 minutes. Participants can distribute the time to each block however they would like. Participants should indicate their progression to the judges when transitioning to each block and when completing the competitive task.

### 2.1. Renovation time

Participants install their infrastructure inside of the area where infrastructure can be installed. Participants shall indicate to the judges when they have finished their renovations or if renovations are not required.

### 2.2. Setting time

Participants next set up their mobile robot. Participants shall place the mobile robot to perform the task in the home station outside the restroom area or in an initial position anywhere inside the area where infrastructure can be installed. Participants shall indicate to the judges when they have finished their setup or if mobile robot setup is not required.

### 2.3. Cleaning Demonstration

Judges confirm the preparations have been made, add the simulated urine described hereafter and scatter garbage, and then initiate the start of the demonstration.

Participants operate the task start command for the system that controls the mobile robot and infrastructure.

After the system operations start, participants are not allowed to control the robot or take any actions that will influence the operation of the system. Participants who initially manipulate the operations of the system shall be



withdrawn from the task at that point.

However, participants can decide to retry the task as described hereafter if continuing the demonstration is deemed difficult due to system malfunction.

### 3. Details of Challenge

The challenge will have a maximum score of 100 points:

- Cleaning the simulated urine: 50 points
- Cleaning the garbage: 50 points

#### 3.1. Cleaning the Simulated Urine

Judges disperse simulated urine (300 ml) around the restroom by spraying the simulated urine around the toilet bowl with the toilet seat open using a sprayer (peeing boy statue).

Images will be taken to record the state of the restroom before spraying the simulated urine as well as before and after cleaning, and the removal rate of the simulated urine will be measured. The full 50 points is given to participants with an 80% or higher removal rate. The simulated urine left in the restroom area after scoring will be cleaned by venue staff.

#### 3.2. Cleaning the Garbage

Judges scatter a total of five pieces of garbage randomly composed of four scraps of toilet paper (maximum length of approx. 5 cm) and one toilet paper roll. Furthermore, the garbage will be scattered after the simulated urine is sprayed and may become damp due to the simulated urine that is dispersed. The restroom will be deemed as clean by either throwing the garbage in the garbage can or storing the garbage inside the robot itself. Participants are allowed to decide the shape of the garbage can and this garbage can may be placed in the area for the mobile robot and infrastructure installation during the renovation time or setting time. 10 points will be awarded for each piece of garbage that is cleaned. (Maximum of 50 points)

#### 3.3. Retry

Participants can ask the judges to terminate the demonstration to retry the task if the system malfunctions and continuing the demonstration is deemed difficult during the cleaning task.

However, the clock will continue to run while the demonstration is stopped. Furthermore, the mobile robot and infrastructure shall be returned to its



initial state. The points awarded for cleaning the simulated urine shall be a reference score (in other words, cleaning will be 0 points and multiple participants with the same score shall be determined superior or inferior based on the removal rate). Participants shall keep the points already earned for pieces of garbage that have been cleaned, the garbage still left to clean will be returned to its position before the demonstration was stopped, and then the task will resume.

## 4. Specifications and Restrictions

### 4.1. Standard Toilet Bowl

The standard toilet bowl and toilet seat installed at the venue are as follows:

- Toilet bowl: TOTO Pure Rest QR
- Toilet seat: Standard toilet seat for above

Furthermore, simulated urine will be sprayed while the toilet seat is up.

### 4.2. Original Toilet Bowl

Participants can use a toilet bowl that has unique geometry and functionality instead of the standard toilet bowl. However, the original toilet bowl must satisfy the following requirements:

- The toilet bowl has standing water and flushes.
- The toilet bowl can be used for both stool and urine.
- The toilet seat is down when sitting and the height of the toilet seat is approximately 400 mm from the floor.
- The toilet bowl accommodates men to stand and pee.
- The toilet must have a projected area of approximately W370 x D530 mm protruding from the floor.

### 4.3. Floor

The floor will be a vinyl chloride sheet.

### 4.4. Mobile Robot and Infrastructure Restrictions

#### 4.4.1. Hardware Restrictions

- There are no restrictions for the number of mobile robots.
- Each mobile robot must take up less than 1 m x 1 m of floor space and all of the mobile robots must fit into the home station.
- The initial position of mobile robots must fit in the area to install

infrastructure if the mobile robots will be placed inside the area to install infrastructure.

- The initial position of infrastructure must be within the area to install infrastructure.
- Mobile robots and infrastructure may not have an external supply of water. However, a total of one liter of water may be built-in to use.
- The use of cleansers is prohibited.

#### 4.4.2. Software Restrictions

- The robots and infrastructure must move autonomously after the start of the competitive task. However, participants may monitor the internal status remotely to learn the state of their system.
- Mobile robots are prohibited from moving outside of the convenience store.
- The mobile robot must exit the restroom area or return within the area to install infrastructure. Infrastructure must return to the area to install infrastructure.

#### 4.4.3. Energy Source Restrictions

- Participants shall prepare an energy source to use for their robots.
- A power supply within AC100V/1500W is planned as the energy source for participants to use.
- Any energy source deemed to be dangerous or inappropriate for use will not be permitted.

#### 4.4.4. Venue Restrictions

- Participants are prohibited from intentionally flooding, staining or damaging the convenience store or restroom area.
- Infrastructure can be removed immediately after the competitive task ends to return the venue to its original state.
- The convenience store has no ceiling or walls.

#### 4.4.5. Safety Restrictions

- Systems must have an emergency shutdown switch in case of an emergency. All of the movable parts included in the system must immediately stop operation if the emergency shutdown switch is pressed.



- The design must prevent the system from tipping over at all times, including during an emergency stop.
- Measures must be put in place to shield any area with a danger of entangling the arms or legs of people in the vicinity.
- Hot areas and sharp edges must not protrude.
- Energy sources utilizing fire or high temperatures are prohibited.
- Any laser used in the system must be class 1 or lower.
- Products and parts of robots must not eject anything.

## 5. Other

This rulebook is subject to change without notice.